

# CONTRIBUTION TO THE FLORISTIC STUDY OF THE BOUTALEB MASSIF: PROPOSAL OF A DEVELOPMENT MODEL

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**Abstract:** *The Boutaleb massif is a massif located in the Hodna Mountains constituting a hinge between the high plateaus of Setif and the Saharan atlas. The Boutaleb massif extends from an altitude of 700m in the south at the edge of the forest. The work carried out in the Boutaleb massif clearly demonstrates the presence of phytosociological classes of degradation, one cites the Onido-Rosmarinetea class; the class of Lygeo-Stipetea, the plant groups within each phytocenosis, corresponds to a stage in a regressive series of vegetation and the relationship which then binds these groups, is of a dynamic order. This study made it possible to make a floristic inventory of the whole massif: the flora is very rich, containing more than 338 species and 213 genera, belonging to 54 botanical families. The endemic element is relatively well represented, with 4.30% of the flora of the region (14 species listed). To this is added a significant faunal wealth with 72 bird species, 11 mammalian species and 7 reptile species. The interest presented by these northern plant and animal species at the southern limit of their habitat, hence the need for their protection and the preservation of their ecological habitat, which must be included in a development model which will serve as a to decision makers.*

**Keywords:** *Massif, Floristic diversity, Model, Endemic, Boutaleb*

## 1. Introduction

The Mediterranean region is considered one of the world's "hotspots" (an area of great importance) given its exceptional concentrations of biodiversity. However, the unique richness of the region is at risk as biodiversity continues to decline very rapidly due to human pressure leading to habitat fragmentation, degradation and loss and species extinction. As biological diversity decreases, our awareness of its importance increases, highlighting the fact that urgent measures must be taken at all levels to manage this critical issue in the Mediterranean region.[1]

In an effort to identify the areas of highest biodiversity and most threatened on the globe, conservation biologists have defined biodiversity hotspots, areas of high conservation priority.[2] These hotspots harbor a high species and endemic richness, and they have suffered significant losses of natural habitats caused by intense anthropogenic impacts on this basis, 10

regional hotspots of Mediterranean biodiversity have been identified [3].

Estimated at 25,000 species or 30,000 species and sub-species, the floristic richness of the Mediterranean region is equivalent to approximately 10% of the higher plants of the globe present on only 1.6% of the earth's surface. [4]

According to Médail & Quézel (1997) [4] ; Vêla & Benhouhou (2007) [5] , several regions in Algeria remain poorly explored to this day, including those classified as "hot spots", but also certain biogeographical transition zones between the Tell Atlas, the high steppe plains and the Saharan Atlas.[6]

The Hodna Mountains have a remarkable and original flora; several of its massifs have already been considered as "important areas for plants", namely Djebel Dréat, Djebel Boutaleb, and Belezma. [6, 7] The diversity, the value of this heritage flora, particularly in terms of floristic studies, ecology and ethnobotany are essential [8, 9].

Knowledge of biodiversity and territories begins with their inventory. The inventory of biodiversity in a given territory is a stimulating exercise, combining geographical curiosity and a scientific approach. But it requires experience, skill and method to successfully observe and recognize taxa and approach completeness [10]. The Boutaleb massif has been the subject of many works. The first works were based on the geology of the massif (Brossard, 1866; Peron, 1870; Cotteau et al., 1884; Ficheur, 1893; Savornin, 1920; Bertraneu, 1952 and 1955).

Studies that are interested in the flora and vegetation of this region have been less important than that of geological studies. Initially, these studies were limited to the discovery of a few endemic species or which were not reported in Algeria, the time of the first surveys of this massif [11, 12, 13].

## 2. Methodology

The Boutaleb massif is a massif located in the Hodna Mountains constituting a hinge between the high Setifian plateaus and the Saharan atlas (Fig.1), its geographical location plays an indisputable role in defense against the harmful climatic influences in the south and in the arid regions. Currently, this natural barrier is subject to enormous human pressure (grazing, clearing, logging, etc.), thus the interest in participatory approaches and the vision of forward-looking management involve all the actors directly or indirectly acting on the environment.

Solon Boudy (1955) [14] the dominant forest of Boutaleb has not been developed, but the exploitations have been concentrated in the fairly dense and intensified parts, especially during the war.

The Boutaleb massif extends from an altitude of 700 m in the south at the edge of the forest, to 1888 m in the center at Djebel Afghan. It is characterized by significant topographic and floristic heterogeneity.

The bioclimate is semi-arid at low altitudes with cool winters in the north and cold in the south,

while sub-humid with very cold winters dominates the altitudinal parts. The dry season lasts five months at low altitudes, and three months at high altitudes.

The Boutaleb forest is essentially made up of spontaneous ecosystems with Aleppo pine (16,100 hectares), cedar (1,300 hectares), holm oak (18,000 hectares) and junipers (540 hectares)

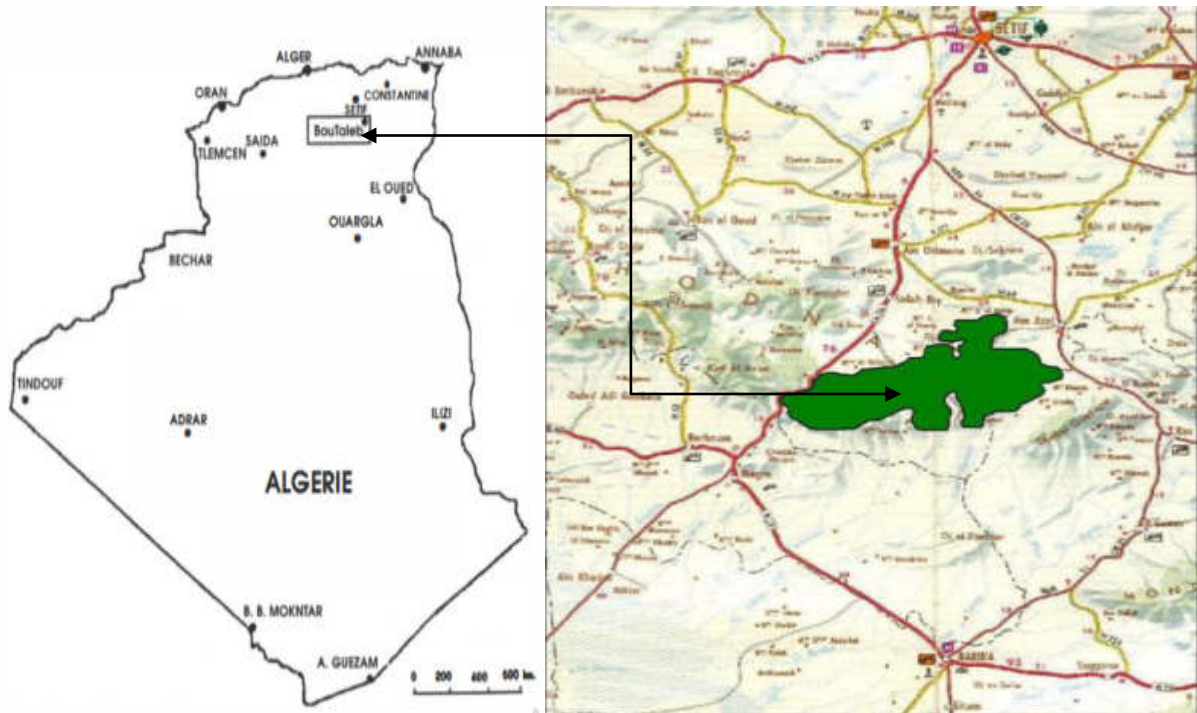
The Aleppo pine forests are generally located on the northern slopes of the plot, and on the southern slopes, these formations are concentrated in the middle but with smaller extensions. Aleppo pine forests have individualized structures, with regular structures in the young stage (saplings, stems and young tall forests) and irregular structures with garden-like and sub-regular patterns in the adult and old stages.

Holm oak forests occupy the central-eastern part of the plot. This species is almost exclusively present in simple (primary) bushes. Pure cedar occupies a relatively large area. But its potential area could be much larger, and it seems to disappear entirely from the southern slopes.

In order to know the floristic richness and diversity of Djebel Boutaleb, the floristic list and the species of medicinal interest of the study area are established from the floristic inventories carried out between the outing campaigns ranging from 2019-2020 during the months of April, may and june, in several stations.

For the determination of the plant species, we used the new flora of Algeria of Quézel and Santa, (1962, 1963) [12] and of North Africa of Maire (1952–1987) [15] supplemented if necessary by the flora of Corsica by Jeanmonod and Gamisans (2007) [16].

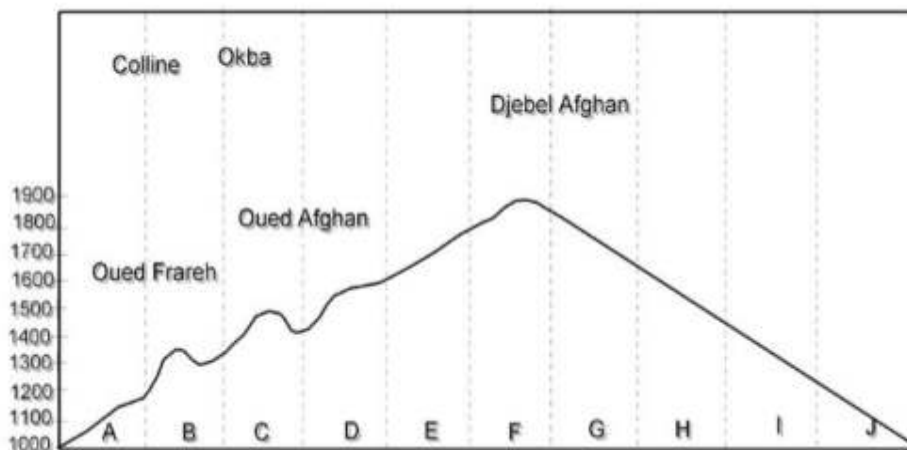
Rarity and endemism in Algeria are informed from the only reference flora for Algeria by Quézel and Santa (1962, 1963)[12]. The analysis of this flora allowed us to bring out a list of medicinal plants in the Boutaleb region, aromatic plants, plants of economic interest (Fig.2, Table 1).



**Fig.1.** Geographical location of the study area of the Boutaleb Forest

**Table 1.** Simplified diagram of the distribution of forest formations in the Boutaleb

Bioclimatic floor	Semi-aride 300>P<600 mm/an	Sub-humide P>600 mm/an
<b>Vegetation stage</b>	Lawn skinned thorny xerophytes	
<b>Alti-mediterranean</b> 1750m<Alt <1888m		
<b>Oro-mediterranean</b> 1400m<Alt<1800 m	<i>Cedrus atlantica</i> Manetti.	<i>Quercus ilex</i> L.
<b>Meso-mediterranean</b> 1300 m<Alt< 1500 m	<i>Quercus ilex</i> L.	<i>Pinus halpensis</i> Mill.
<b>Thermo-mediterranean</b> 1000m<Alt<1300 m	<i>Phillyrea angustifolia</i> L. <i>Pistaciz lentiscus</i> L. <i>Juniperus Phoenicia</i> L. <i>Ampelodesma mauritanica</i> Pir. Dur. <i>Rosmarinus tournefortii</i> Noé. <i>Globularia alypum</i> L.	<i>Pinus halpensis</i> Mill.



**Fig.2.** Spatial distribution of spontaneous vegetation along a north-south transect Djebel Boutaleb

- A. Matorral a *Pinus halepensis* Mill. et *Quercus ilex* L.
- B. Matorral a *Quercus ilex* L.
- C. Forêt dense de *Cedrus atlantica* Manetti.
- D. Forêt claire de *Cedrus atlantica* Manetti.
- E. Pelouse ecarchée
- F. Matorral arboré
- G. Matorral a *Quercus ilex* L.
- H. Matorral a *Pinus halepensis* Mill. et *Quercus ilex* L.
- I. Forêt dense de *Pinus halepensis* Mill.

### 3. Results and discussion

#### 3.1. Floristic diversity

Field trips and ethnobotanical surveys during the period 2019 to 2020 led to the development of the floristic richness within the massif with 338 taxa belonging to 213 genera and 54 families.

#### 3.2. Generic richness

The number of botanical families listed is 54: the Asteraceae family has 39 genera, followed by the Fabaceae family, which has 20 genera. With 19 genera, the Poaceae are one of the most well-represented families.

The Brassicaceae and Apiaceae have 14 genera each, Caryophyllaceae and Lamiaceae have 10 genera each, and the remaining families have 7 to 1 genera each. With a clear representation of the relationship that binds the genera of the species according to their membership in the botanical families.

#### 3.3. Specific richness

The best represented botanical families are the Asteraceae (50 species), Fabaceae (41 species), Poaceae (32 species), Brassicaceae (22 species), Apiaceae and Caryophyllaceae (19 species), Lamiaceae (17 species), Cistaceae and Liliaceae (12 species), the remaining 45 families are each represented by number between 8 and 1 of species (Table 2).

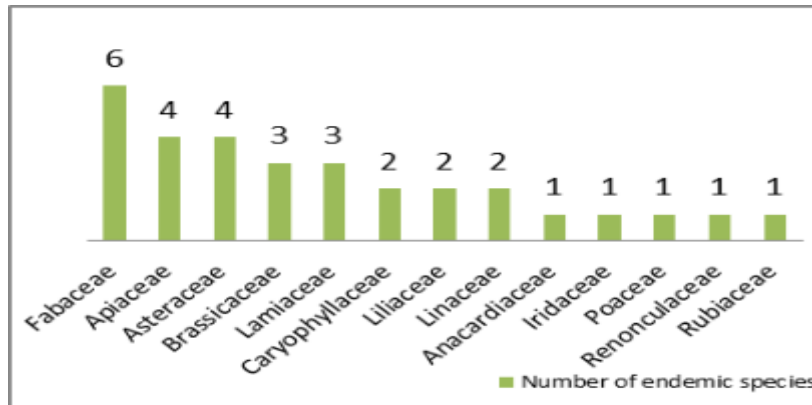
#### 3.4. Endemic species

The inventory carried out at the level of the study area has made it possible to identify 30 endemic species belonging to the phytochorological.

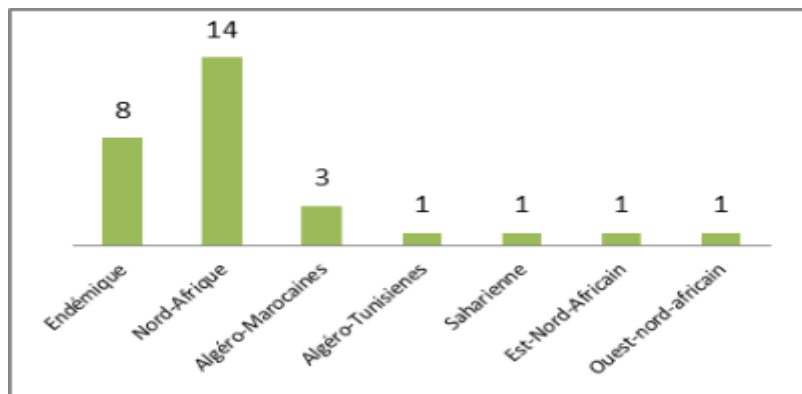
The Fabaceae family is the most represented with 6 species, followed by the Apiaceae family and the Asteraceae with 4 species, the Brassicaceae and the Lamiaceae with 3 species, and the others two or one species (Fig. 3, 4).

**Table 2.** Distribution of species in the Boutaleb forest by botanical families

Botanical families	Number of species	Botanical families	Number of species	Botanical families	Number of species
Asteraceae	50	Resedaceae	4	Aceraceae	1
Fabaceae	41	Cupressaceae	3	Apocynaceae	1
Poaceae	32	Linaceae	3	Caprifoliaceae	1
Brassicaceae	22	Oleaceae	3	Chenopodiaceae	1
Apiaceae	19	Papaveraceae	3	Convolvulaceae	1
Caryophyllaceae	19	Polygalaceae	3	Cypéraceae	1
Lamiaceae	17	Primulaceae	3	Ephedraceae	1
Cistaceae	12	Renonculaceae	3	Euphorbiaceae	1
Liliaceae	12	Rhamnaceae	3	Fagaceae	1
Rubiaceae	8	Abietaceae	2	Globulariaceae	1
Geraniaceae	7	Anacardiaceae	2	Malvaceae	1
Scrofulariaceae	7	Campanulaceae	2	Orobanchaceae	1
Rosaceae	6	Ericaceae	2	Plumbaginaceae	1
Crassulaceae	5	Iridaceae	2	Polypodiaceae	1
Cynaraceae	5	Orchidaceae	2	Rutaceae	1
Borraginaceae	4	Polygonaceae	2	Saxifragaceae	1
Dipsacaeae	4	Solanaceae	2	Salicaceae	1
Plantaginaceae	4	Valerinaceae	2	Thymeleaceae	1



**Fig.3.** Number of endemic species per family within the Boutaleb forest



**Fig.4.** Level of endemism

### 3.5. Rare species

The study area contains 147 rare species belonging to 37 families with rare, fairly rare, very rare and extremely rare abundance. The families of Fabaceae 24, Asteraceae 22, Brassicaceae 16, Poaceae 11 and Apiaceae and

caryophyllaceae 7 species. Some of these rare species deserved a review of their conservation status, and therefore became placed on the red list from the International Union for Conservation of Nature (IUCN) (Table 3).

**Table 3.** Rare and protected species

Rare species (IUCN, 1980)	Protected no cultivated species ( Decoree No.93-285,1993)
<i>Carum montanum</i> <i>Hedysarum perralderianum</i> <i>Senecio gallerandianus</i>	<i>Allium moly</i> <i>Cedrus atlantica</i> <i>Crupina vulgaris</i> <i>Pistacia atlantica</i> <i>Senecio gallerandianus</i>

## 4. Development plan

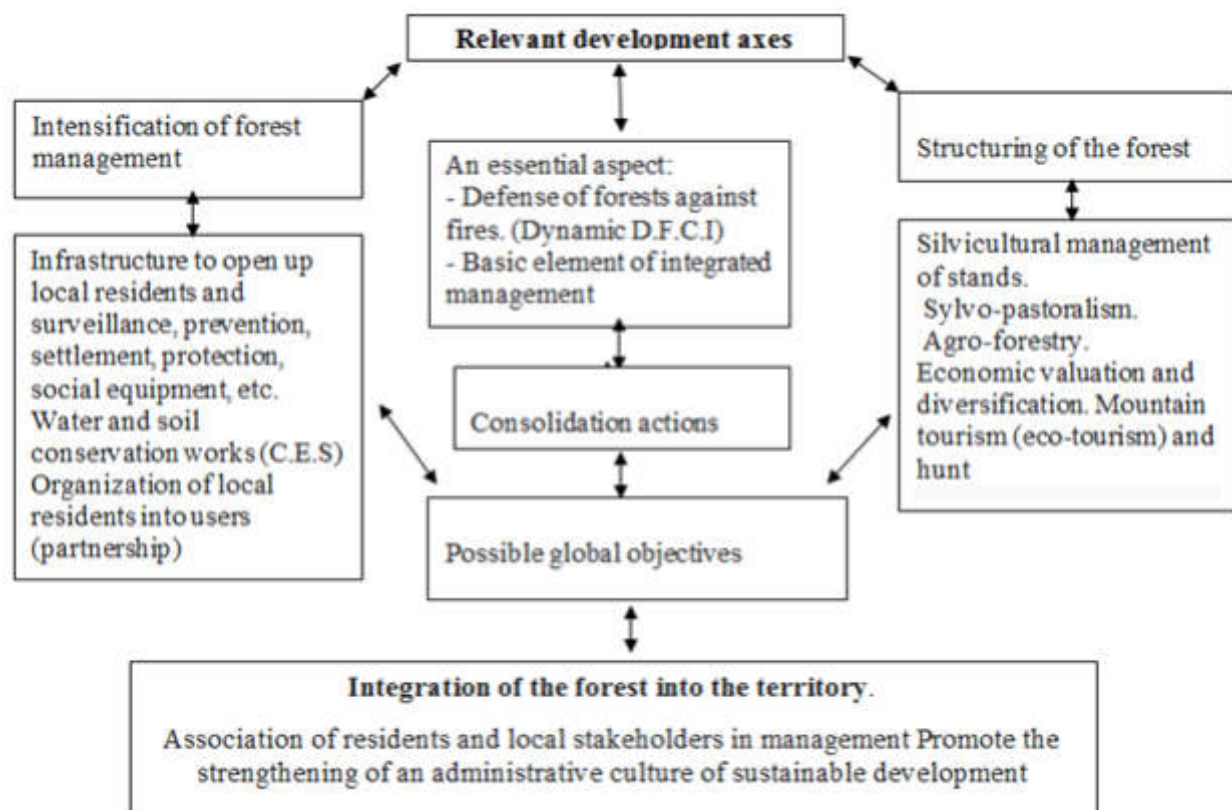
For sustainable development, natural resources must be managed and conserved to meet the needs of present and future generations. Regarding the forest ecosystem; it is a matter of conserving land, water, plant and animal heritage and enhancing them using technical means that are economically and socially appropriate and respectful of the environment.

Each development action is conditioned by a set of laws defined themselves by ecological and biological studies of all the elements of the territory to be developed.[17] The results of the various floristic, ecological and socio-economic analyzes combined with each other, make it possible to define a management plan.

Daget and Godron (1974) define development as "the organization of space, so as to enhance, through appropriate equipment, the natural resources of the place and satisfy the

needs of the populations concerned". In the forestry domain, planning does not deal solely with the organization of timber harvesting through silviculture planning, but it also seeks projective measures capable of safeguarding natural resources while using their potential [18]. According to the legislation, *Article (37-38-39 and 40 )of the law n°84/12 of June 23- 1984,*

fixing the methods of installation, exploitation, and management of the forests defines the operation as being the implementation, on the basis of objectives and a plan, agreed in advance, of a certain number of activities and investments, with a view to the sustained production of the forest, without causing adverse effects on the social environment.



## Conclusions

The purpose of this study is therefore to mend subsequent work on the same question in order to finalize at least part of the management of the existing heritage of the southern of Setif through the varietal diversity of medicinal plants and aromatics, as well as their various uses local population. This will be achieved by preparing a development plan, which will serve as a tool for decision-makers to rationally manage this natural heritage on ecological bases to protect the endemic and rare species of the whole study area.

Tables are numbered using Arabic numerals, the table number is placed in the upper-right part, above the table.

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